### INTRODUCTION

Understanding the absorption of high-frequency (HF) radio waves within the ionospheric D, E, and F regions remains a pivotal challenge in accurately modeling signal propagation. This study investigates HF signal reception using the HamSCI Personal Space Weather Stations (PSWS) W2NAF near Scranton, Pennsylvania and models those results using the PHaRLAP HF raytracing toolkit and the International Reference Ionosphere (IRI).

### HAMSCI PERSONAL SPACE WEATHER STATION

- The HamSCI Personal Space Weather Station (PSWS, hamsci.org/psws) is a NSF-funded Distributed Array of Small Instruments (DASI) project.
- We use observations from PSWS software defined radio (SDR) instrument known as the WSPR Daemon-Grape, which uses the RX-888 HF SDR, KA9Q-Radio & WSPRDaemon Software, and a GPSdisciplined oscillator to make precision frequency measurement.
- The system is capable of receiving multiple bands simultaneously from 0.5-60 MHz.







Figure 2: WWV Transmitter near Fort Collins, CO, [2]

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- 15, and 20 MHz. We use these as signals of opportunity.
  - amplitude variations to the carrier signal.
- In our experiment, we place our receiver near Scranton, PA (Figure 4).



Figure 4: Transmitter-Receiver relative locations per Earth's elliptical model

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# Challenges in Modeling HF Absorption: Exploring D, E and F-Layer Effects on Signal Attenuation Using Provision of High-frequency Raytracing Laboratory for **Propagation studies**

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absorption at 20, 15, 10, 5 MHz (Figures 5 – 8).

Compared with modeled absorptions for better understanding













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